

6. FREIGHT FLOWS AND ASSIGNMENTS

This section of the report examines freight flows in Indiana and, to a lesser degree, the intermodal component of those flows. The research stems primarily from the recently published report from Dr. Bill Black at Indiana University (Bloomington), Transport Flows in the State of Indiana: Commodity Database Development and Traffic Assignment, Phase 2. A summary of this body of work (hereafter referred to as the "Transport Flows Study", along with selected extracts germane to the IMS Study, follows a brief discussion of national, intermodal traffic trends.

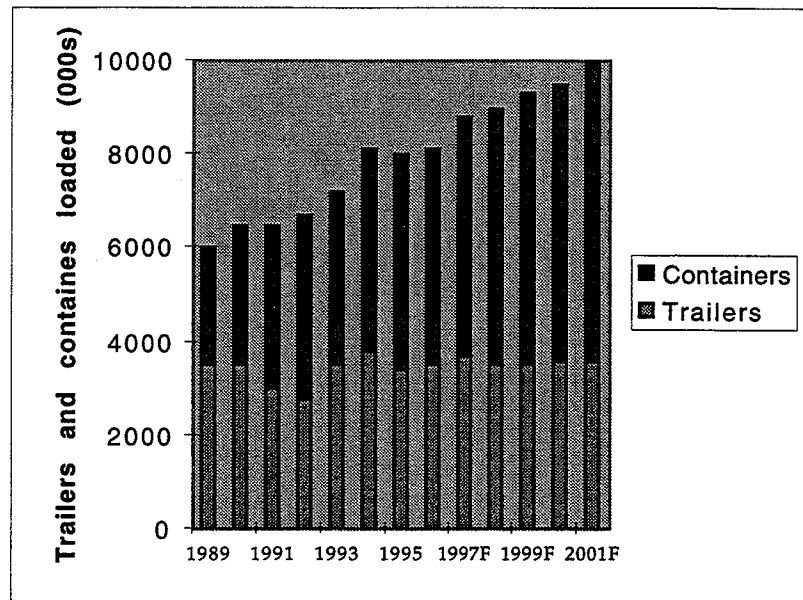
6.1 National Intermodal Transportation Trends

Over the last ten years, the freight industry has become increasingly efficient in the way it provides the delivery of goods. Freight railroads, which move the bulk of U.S. freight, have broken records every year since 1987, reaching nearly 1.3 trillion ton-miles in 1995. Driving forces behind this industry transformation have included major new carrier alliances (e.g., Burlington Northern / Santa Fe, and Union Pacific / Southern Pacific); selective abandonments; the rationalization of services offered; and the development of integrated information systems. The latter especially has greatly contributed to the rise and growth of intermodal transfers (comprised of truck-rail, truck-air, and truck-water moves). Consider the following statistics¹:

- With the exception of a dip in 1995, intermodal traffic has enjoyed 14 years of solid growth.
- The forecasted growth for intermodal traffic over the next four years is 3.5 percent per year (down from 4.5 percent average growth over the last seven years), as illustrated by the exhibit below. Note container traffic growth is outstripping trailer growth.

¹ "Odyssey 2001: an intermodal forecast", *Railway Age*, April 1997
"Rebound!", *Logistics Management*, March 1997
"Industry indicators", *Railway Age*, February 1997
"Trucking leads the way for IMS growth", *Logistics Management*, January 1997
"Hot wheels", *Distribution*, Radnor, October 1996
"Trucking spurs IMC growth", *Logistics Management*, August 1996
"Hitting the wall", *Distribution*, Radnor, July 1996
"Wild and woolly", *Distribution*, Radnor, July 1996
"A downward spiral?", *Distribution*, Radnor, March 1996
"What next for intermodal?", *Railway Age*, February 1996
"Is this the golden age of intermodal?", *Distribution*, Radnor, April 1995
"Say cheese: an intermodal snapshot", *Distribution*, Radnor, April 1995
"Intermodal becomes a contender", *Traffic Management*, April 1995

Recent and Forecast Intermodal Traffic Growth 1989-2001



- The intermodal market share is expected to reach 25 percent in 1997, up from 18 percent in 1996.
- Most shippers (72 percent) view truckload (small packages and generally less than truckload) and intermodal (trailers and containers) as different transportation products.
- The percentage of shippers using intermodal increased from 64 percent in 1990 to 77 percent in 1994.

The share of intermodal traffic to total freight moved will likely continue to grow for some time, especially given the current buoyancy of the national economy. An increasing number of partnerships between railroads and private carriers, but also between containerized ocean carriers servicing North America and railroads/motor carriers, are influencing customer perceptions in favor of intermodal. Improved manipulation of computerized shipment data can also contribute to the increased use of intermodal transport. The economics of intermodal transportation tend to beat out truck for time sensitive freight carried distances of 500 miles or more. This distance segment is therefore where the bulk of additional intermodal traffic growth will likely occur.

It is worth mentioning that both the use and growth of intermodal traffic vary widely by region. States with ocean access are more likely to have a higher percentage of their freight moved intermodally through a port than those that are landlocked. In addition,

carrier performance varies by region - Western shippers report the best service; Northeastern shippers report the poorest.

6.2 Transport Flows in the State of Indiana

Transport Flows in the State of Indiana: Commodity Database Development and Traffic Assignment is the second phase of a project designed to identify the nature and volume of commodity traffic on Indiana's highways and railroads. An understanding of this traffic is important in terms of setting priorities for capital investments. The Transport Flow Study's goals were to broaden the range of commodities examined, to model the flow of these commodities on the highways and railroads, to forecast future flows for 2005 and 2015, and to assign these latter flows to the principal modes noted.

The project benefited from the appearance of the 1993 Commodity Flow Survey (CFS) and incorporates numerous data from preliminary publications of that census activity. Fifteen (2-digit STCC) manufacturing sectors, as well as farm products, coal, non-metallic minerals, and waste and scrap were among the commodities examined. The project also looked at the movement of mail, express mail, local solid waste flows, and some container traffic moving through East Coast ports. The rail and highway flows of 21 commodities and two summary groups were forecasted for 1993, 2005 and 2015, and assigned to appropriate networks.

Significant methodological improvements were made during the second phase of the project. The highway network used includes a merged U.S. network with the links of the Indiana State Roadway Inventory. This may be one of the most advanced state networks currently in use in the U.S. A new digital rail network developed for the Federal Railroad Administration was also used here. The project also developed additional commodity traffic production and attraction models. The models developed in that case, as well as the fully constrained gravity models used for traffic distribution were calibrated for 145 "traffic zones", which include 92 counties of Indiana and 53 external (to Indiana) stations that represent the other 47 contiguous states and the District of Columbia. A new method of allocating traffic to modes based on data of the 1993 CFS was also developed here. Flow forecasts were made based on externally supplied population and economic projections.

6.2.1 Commodities Moved

Based on the 1993 Commodity Flow Survey, Indiana originated commodity flows valued at \$178.7 billion. These flows weighed in excess of 285.8 million tons. The major commodities involved in these moves in terms of value were transportation equipment (19.2%), primary metal products (9.8%), food and kindred products (9.5%), electrical machinery (8.9%) and chemicals and allied products (6.4%). The major products in terms of weight were slightly different: petroleum and coal products (21.9%), non-metallic minerals (20.1%), farm products (14.0%), primary metal products (9.8%), stone, clay and glass products

(7.7%), food and kindred products (7.4%), and chemicals and allied products (4.2%). Please refer to the table below.

Value and Tonnage of Major Commodity Groups Originating in Indiana

STCC Code	Value (millions)	Tons (thousands)	Commodity Group
01	\$ 5,794	39,902	Farm Products
11	281	10,759	Coal
14	463	57,341	Non-metallic Minerals
20	16,958	21,039	Food and Kindred Products
22	275	93	Basic Textiles
23	7,795	553	Apparel
24	3,235	4,131	Lumber and Woods Products
25	3,120	734	Furniture and Fixtures
26	3,194	2,814	Pulp and Paper Products
28	11,474	11,957	Chemicals and Allied Products
29	9,008	62,500	Petroleum and Coal Products
32	2,748	21,972	Stone, Clay and Glass Products
33	17,485	27,881	Primary Metal Products
34	10,363	4,572	Fabricated Metal Products
35	9,504	1,023	Machinery, except Electrical
36	15,914	1,909	Electrical Machinery
37	34,401	6,731	Transportation Equipment
40	703	4,474	Waste and Scrap Material
50*	14,811	2,421	Other Manufactured Products

* Category 50 here includes STCC 21 (Tobacco Products), STCC 27 (Printed Matter), STCC 30 (Rubber and Miscellaneous Plastic Products), STCC 31 (Leather and Leather Products), STCC 38 (Instruments, including Medical and Photographic, as well as Watches and Clocks), and STCC 39 (Miscellaneous Products of Manufacturing). However, no data are included here for STCC 27 due to sampling and definition problems regarding shipments in the 1993 *Commodity Flow Survey*.

Destinations of Indiana Shipments

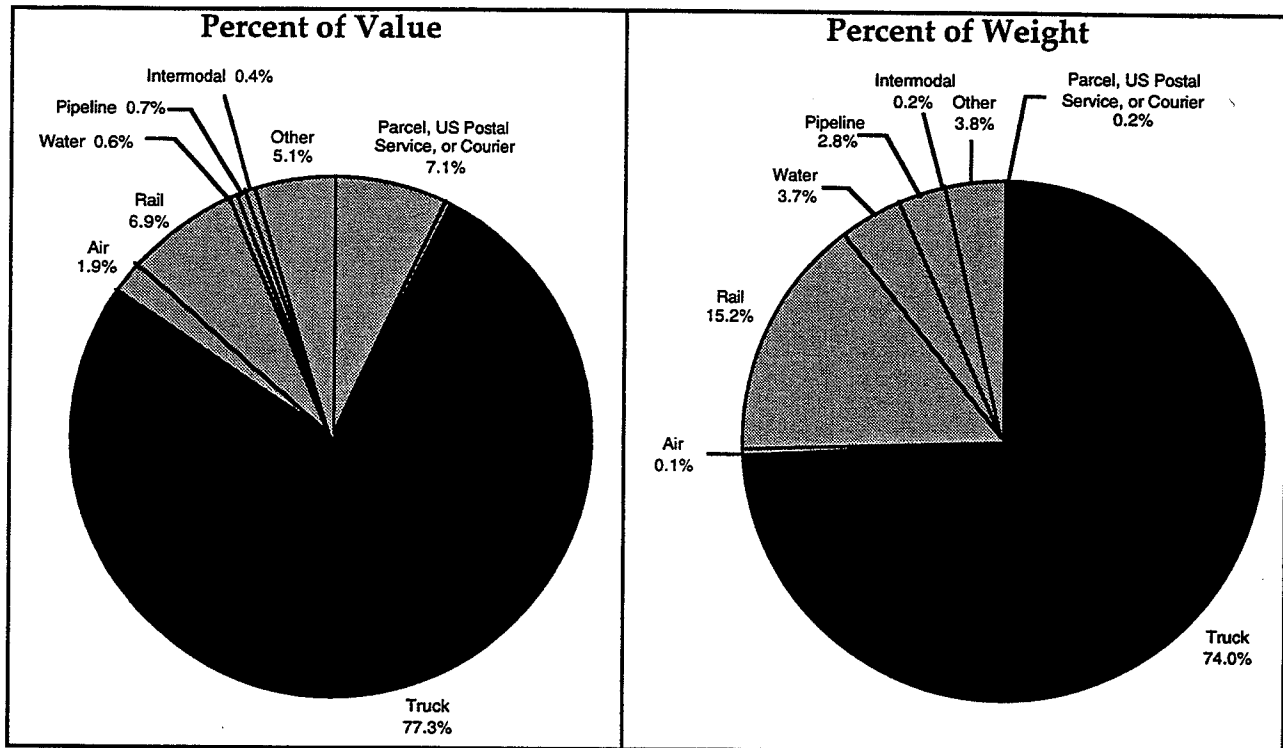
Data are not published at this time on the destinations of Indiana's commodity shipments as such. Data are published on the destinations for "all shipments."² For these data the major destinations in terms of value were Michigan, Illinois, Ohio, California, and Kentucky. The major destinations in terms of weight were Illinois, Michigan, Ohio, Kentucky, and Louisiana. As one might expect, Indiana was the major destination of its own shipments in terms of value or weight. This is typical of most states.

Modal Choices

Mode choices for all shipments originating in Indiana were primarily truck (77.3% in terms of value), but it is considerably higher than that for some of the manufactured goods examined here as will be noted below. Parcel and express mail account for 7.1% (based on value) of the shipments and these are most likely all manufactured goods. Rail moved only 6.9% of the traffic based on value and 15.2% based on weight. Air freight (excluding parcels) and truck-air moves accounted for only 1.9% of the value and .05% of the weight moved. These numbers are not consistent with other national figures in part due to the nature of the data collected. The figures are based on traffic originating in Indiana. Exhibits illustrating the modal choice breakdown by value and by weight are presented on the next page. Traffic passing through Indiana (or the U.S.) or traffic originating outside the country are not included here.

² The 1993 Commodity Flow Survey also looked at the transport of other goods (forest products, fresh fish, metal ores, petroleum, and ordnance) as well as freight forwarding activities. These were not included here because they are insignificant in Indiana (e.g., fish) or data quality was too inferior (e.g., petroleum).

Indiana Shipment Mode Choice



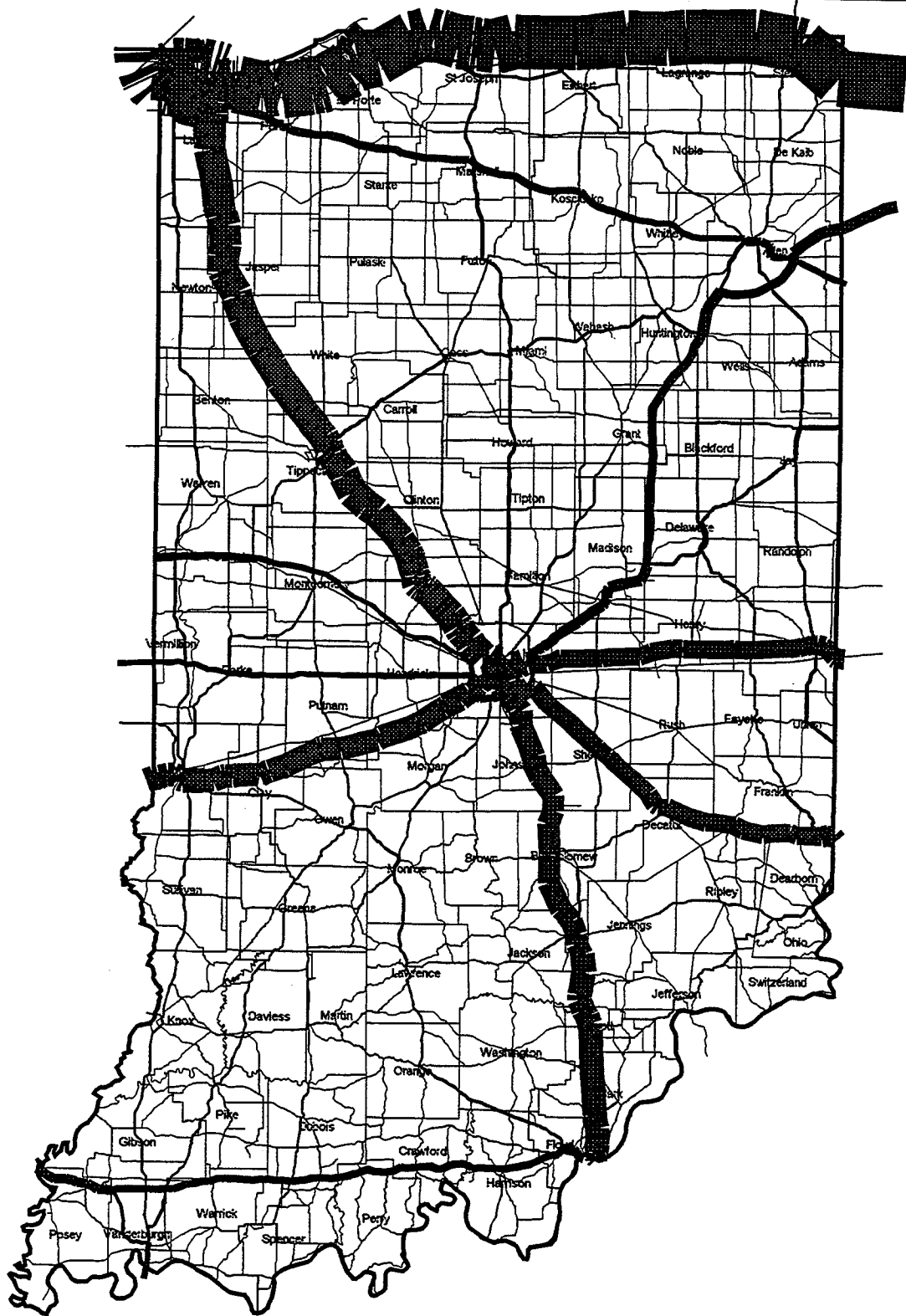
6.2.2 Existing Flows - 1993

This section presents the results from the highway and rail assignments for the CFS year of 1993. The CFS did not include county level data so the Transport Flow Study developed statistical models to allocate traffic produced and attracted to Indiana counties. Flows were then generated between all origins and destinations within the United States, and assigned to the highway network of Indiana and the nation. In order to evaluate this process all of the individual commodity flows (including 15 sets of manufactured goods, four resource-based commodities and two types of mail) were summed by highway segment to yield a total commodity flow by segment. A sample of these segment totals was then statistically compared with Indiana DOT counts of average daily total commercial traffic compiled over the 1991 to 1994 period. The two were found to be significantly related and the assignments were judged as acceptable.

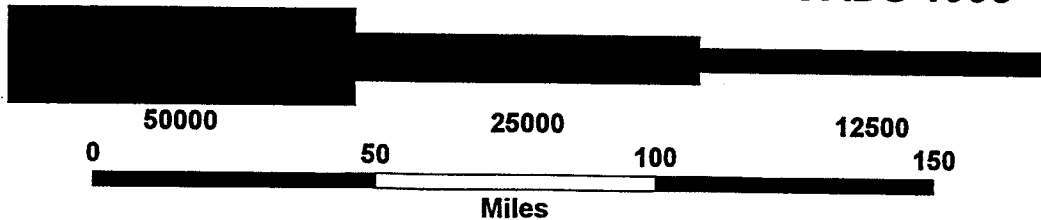
The next twelve pages contain the following assignment maps for 1993:

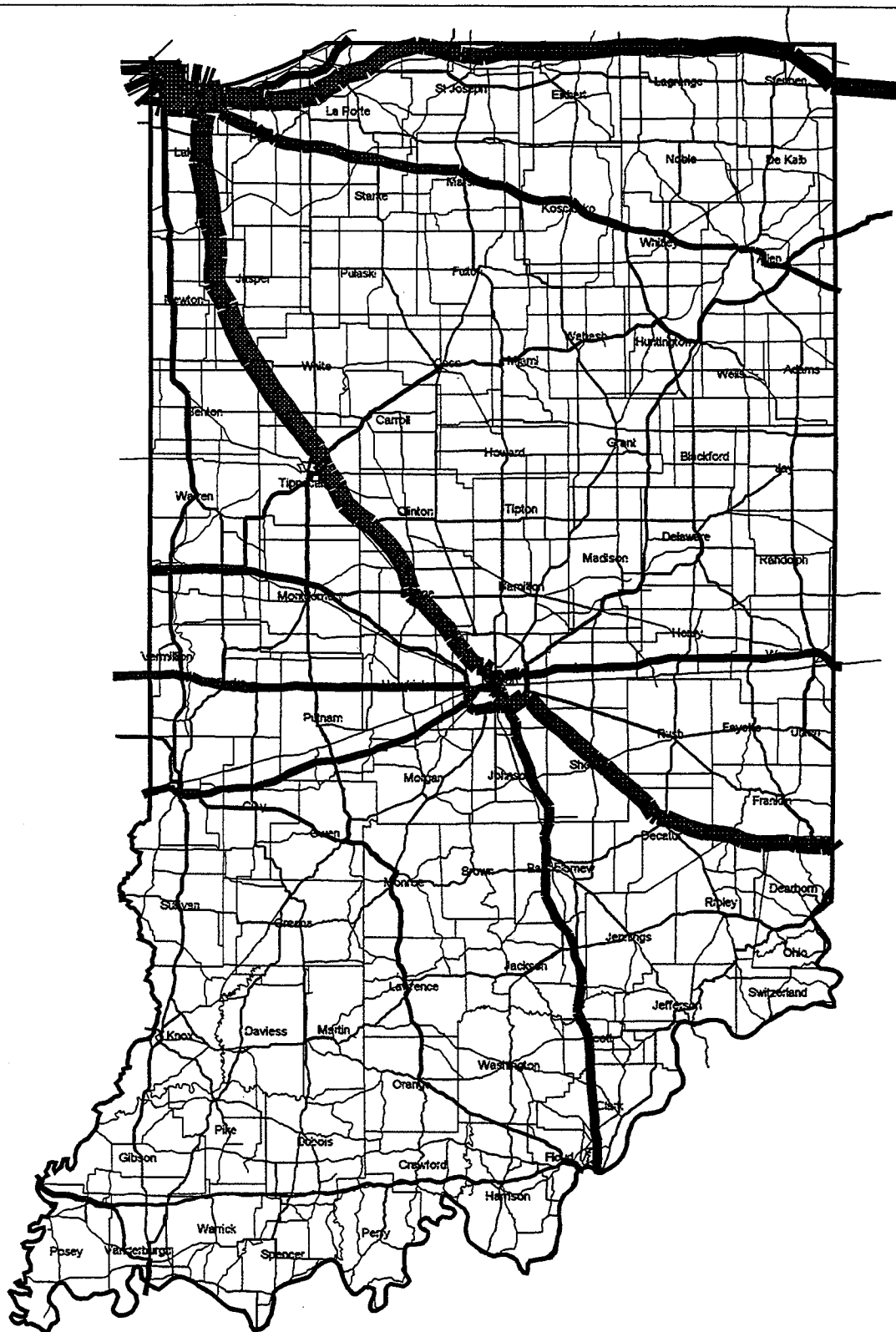
- Truckloads
 - Total commodity flows
 - Farm products
 - Coal
 - Petroleum/coal

- Primary metal products
- Manufactured goods
- Carloads
 - Total commodity flows
 - Farm products
 - Coal
 - Petroleum/coal
 - Primary metal products
 - Manufactured goods.

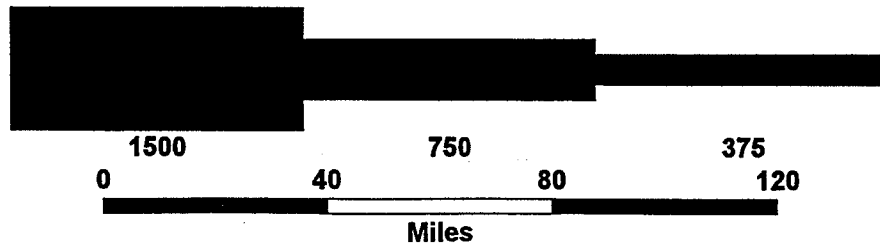


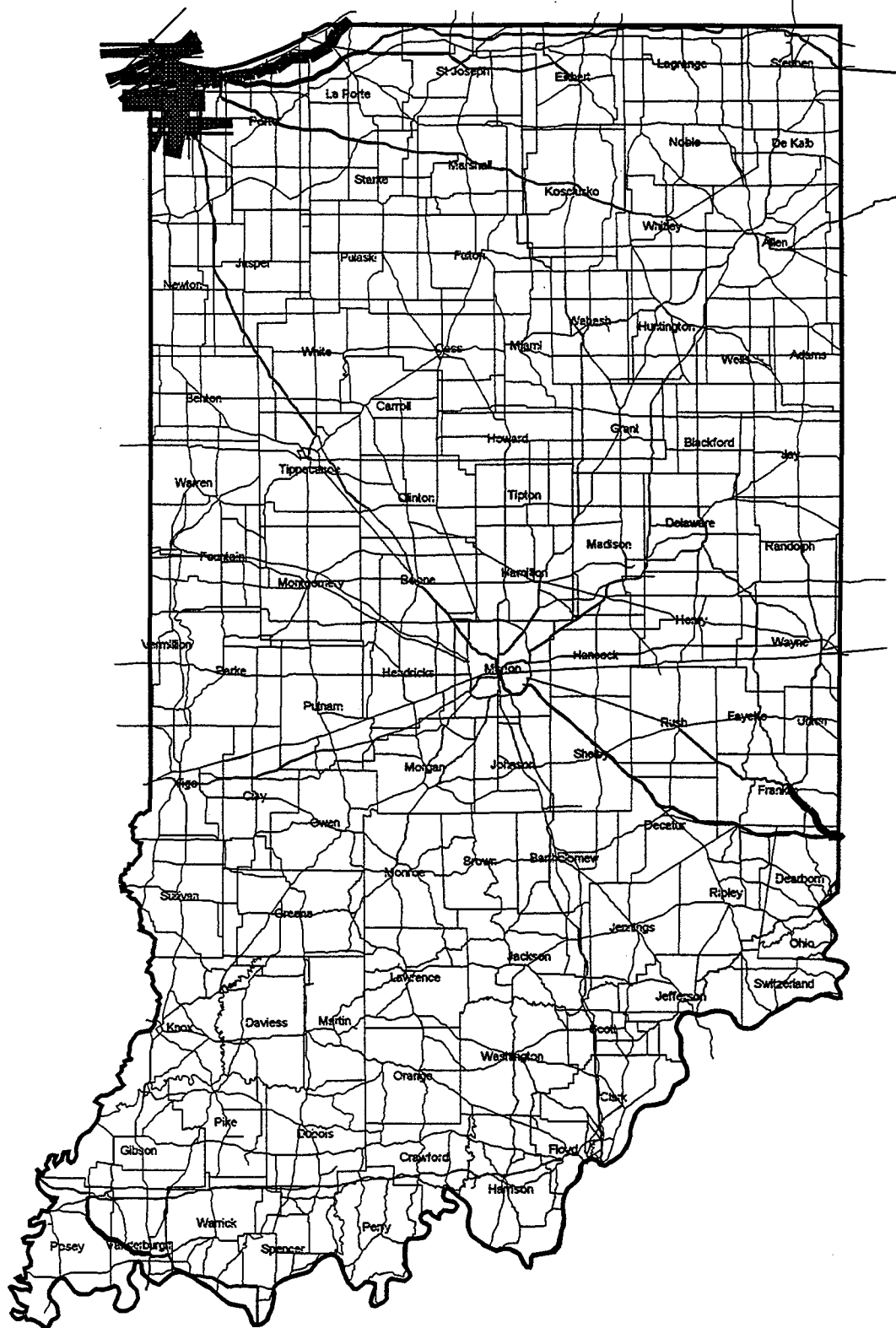
TOTAL COMMODITY FLOW - TRUCKLOADS 1993



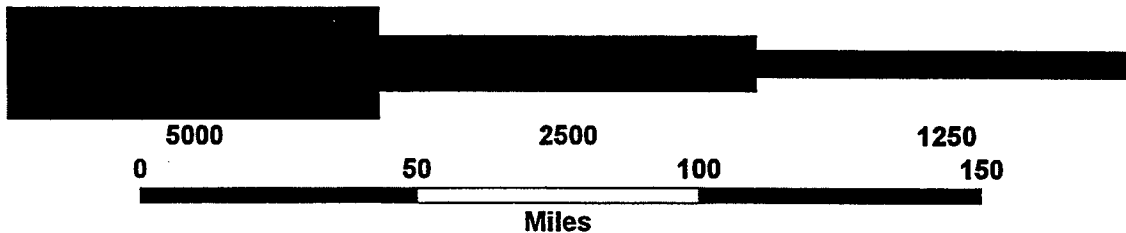


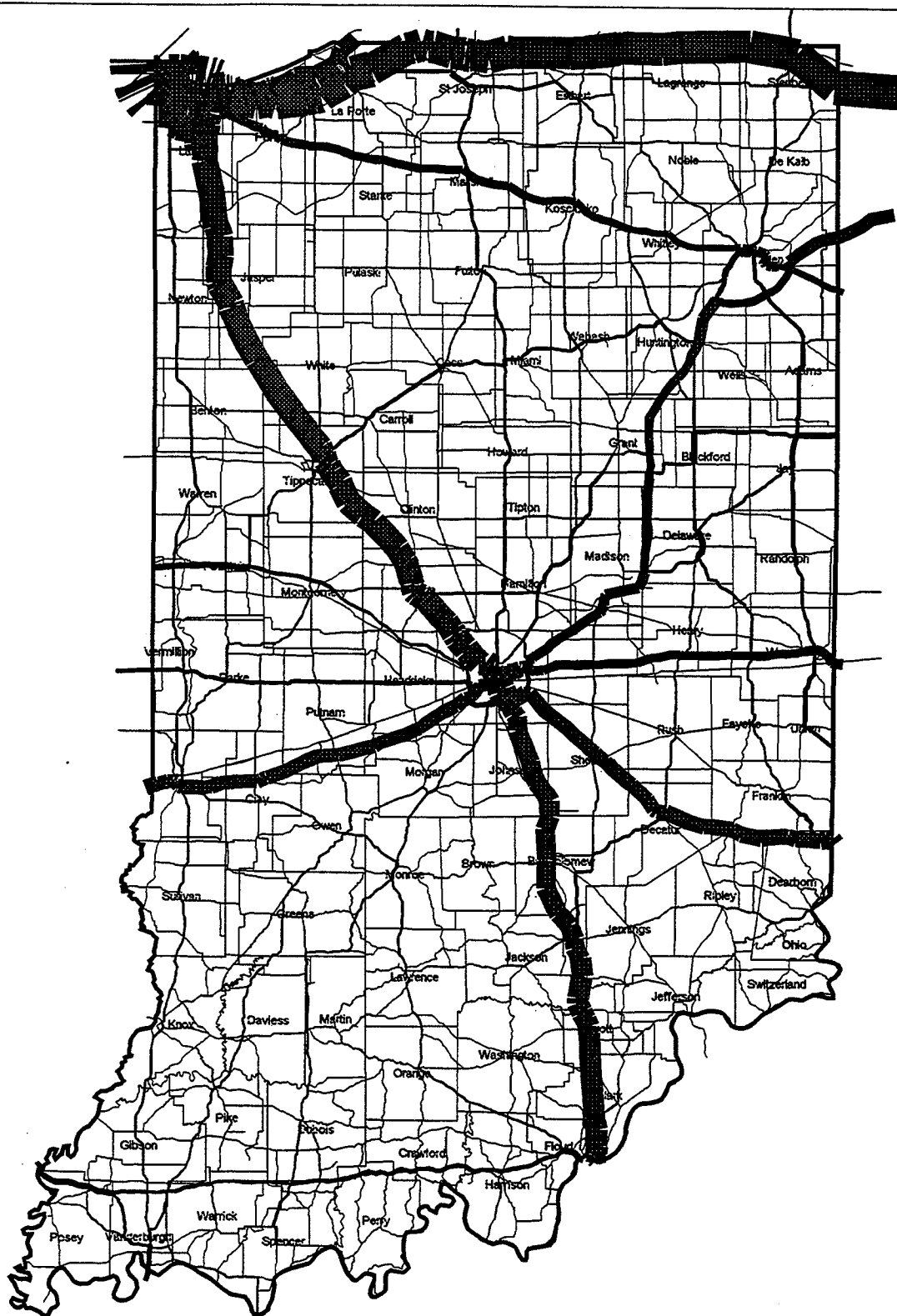
FARM PRODUCTS - TRUCKLOADS 1993



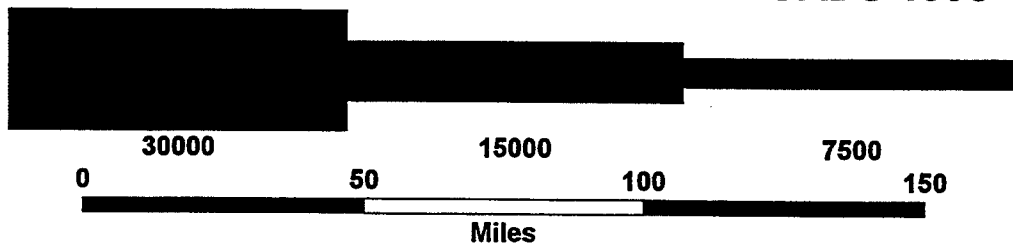


PETROLEUM/COAL PRODUCTS - TRUCKLOADS 1993



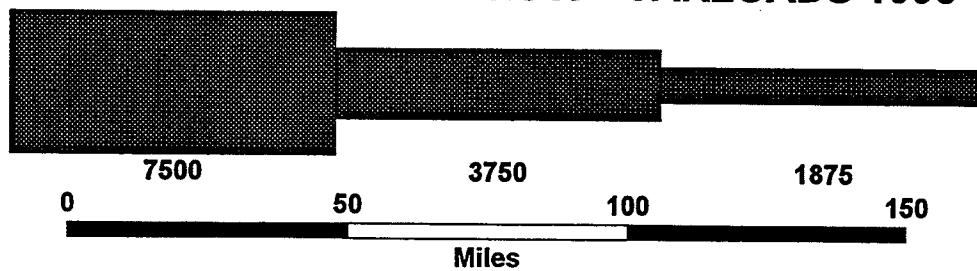


MANUFACTURED GOODS - TRUCKLOADS 1993



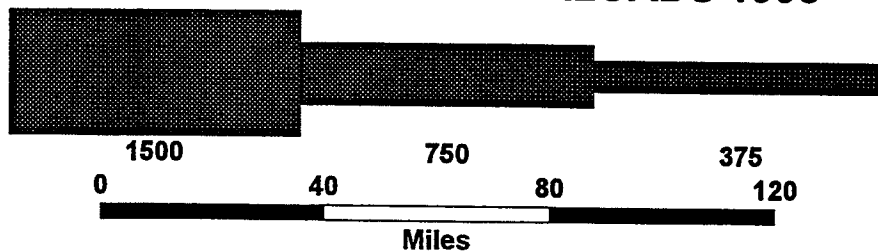


TOTAL COMMODITY FLOW - CARLOADS 1993



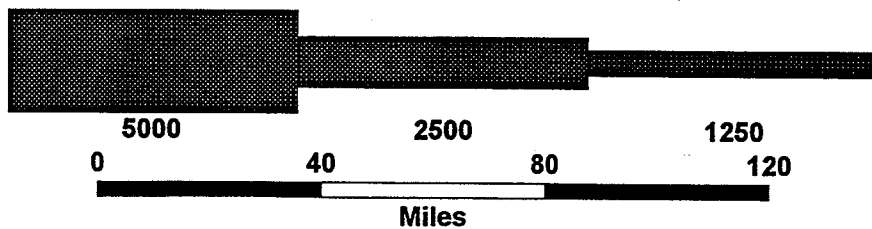


FARM PRODUCTS - CARLOADS 1993



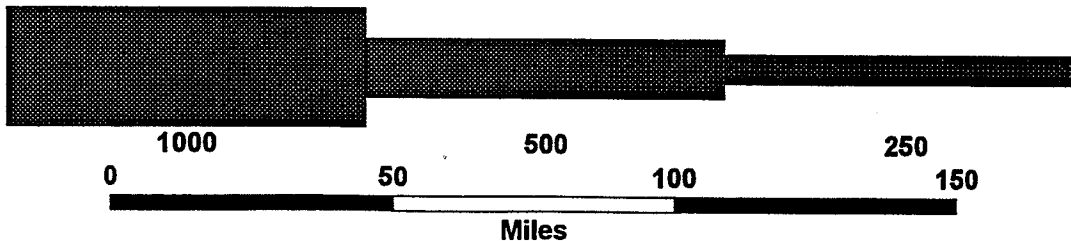


COAL - CARLOADS 1993



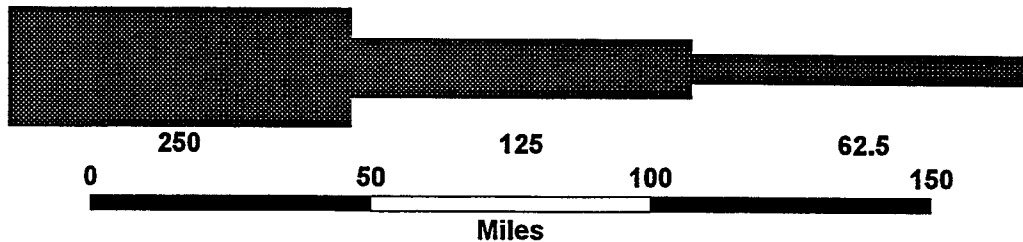


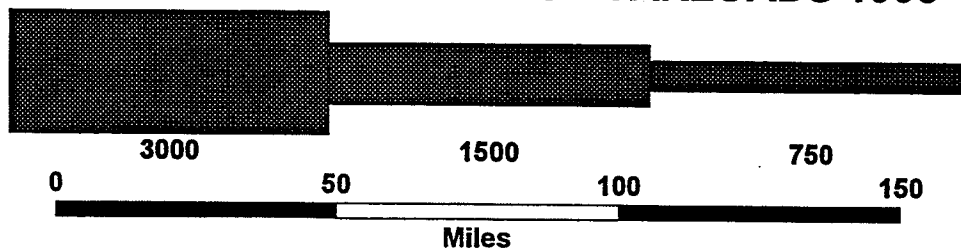
PETROLEUM/COAL PRODUCTS - CARLOADS 1993





PRIMARY METAL PRODUCTS - CARLOADS 1993





From the point of view of the IMS, the highway and rail assignment maps support both the attractions from large urban areas and intermodal facilities (e.g., Burns Harbor), as well as the main sources of production (e.g., oil refineries in Whiting and Hammond). The handling of petroleum products by truck or rail is highly regionalized and limited to Indiana's northwest, suggesting pipelines serve the rest of the State.

With regards to the highway network, I-80/94 is by far the most dominant highway for all commodity types, a testimony to Chicago's industries and those of the whole southern Lake Michigan basin. After that, the key axes all traverse Indianapolis and are fairly well balanced. They reach 12,500 daily truckloads on average and include I-65, I-70, I-74, and to a lesser extent I-69. Not surprisingly, manufactured goods account for the greatest share of all truck movements (roughly 60 percent). Also note that with respect to other flows, coal is disproportionately present in southwestern corner of the State. Significant coal flows link the Illinois border to Evansville and the Ohio river barge traffic through the Southwind Maritime Center and the Mount Vernon Coal Terminal.

With regards to the railroad network, three main axes emerge:

- the East-West CSX route from Gary East to Akron Ohio (which crosses the State line North of Fort Wayne near St. Joe)
- the East-West Conrail route through Indianapolis
- the North-South CSX route from Evansville North to the Illinois State line just West of Olin.

Each of these three axes carries about 3750 daily carloads across its entire length. The CSX route carries 1,000 more carloads per day in the southwest corner of the State, a testimony to the coal productions there headed for Ohio river barges. Coal is carried in higher volumes than any other commodity by rail.

Secondary axes include the Norfolk Southern branches through Louisville (and the Clark Maritime Center), and through Fort Wayne.

6.2.3 Future Flows - 2005 and 2015

Dr. Black's Transport Flows Study also developed commodity flow assignments for the years 2005 and 2015. The average total (absolute) growth expected for commodity flows in the State of Indiana over the time period from 1993 to 2005 is about 7 percent. This average growth is expected to drop to 5.75 percent for the 2005 to 2015 decade. However, the forecasts did not use a state average, but instead developed commodity specific growth rates for each county within Indiana. The forecasts for total commodity flows are presented on the following four pages. Note that the forecasts indicate that by and large there is exceptional

stability in the maps. This is in part misleading because the assigned flows tend to follow the same routes in the future and the traffic increases observed are often not that large. When the increases are significant the band-widths adjust to this as well.

6.2.4 Intermodal Freight Transfers in Indiana

This last section of the Freight Flows chapter contains several short discussions regarding elements of intermodal traffic. Included here are comments on rail/truck facility market access; container traffic, truck-air traffic, and a general discussion of Indiana's share of intermodal traffic and how that compares to the national average.

Rail/Truck Market Access

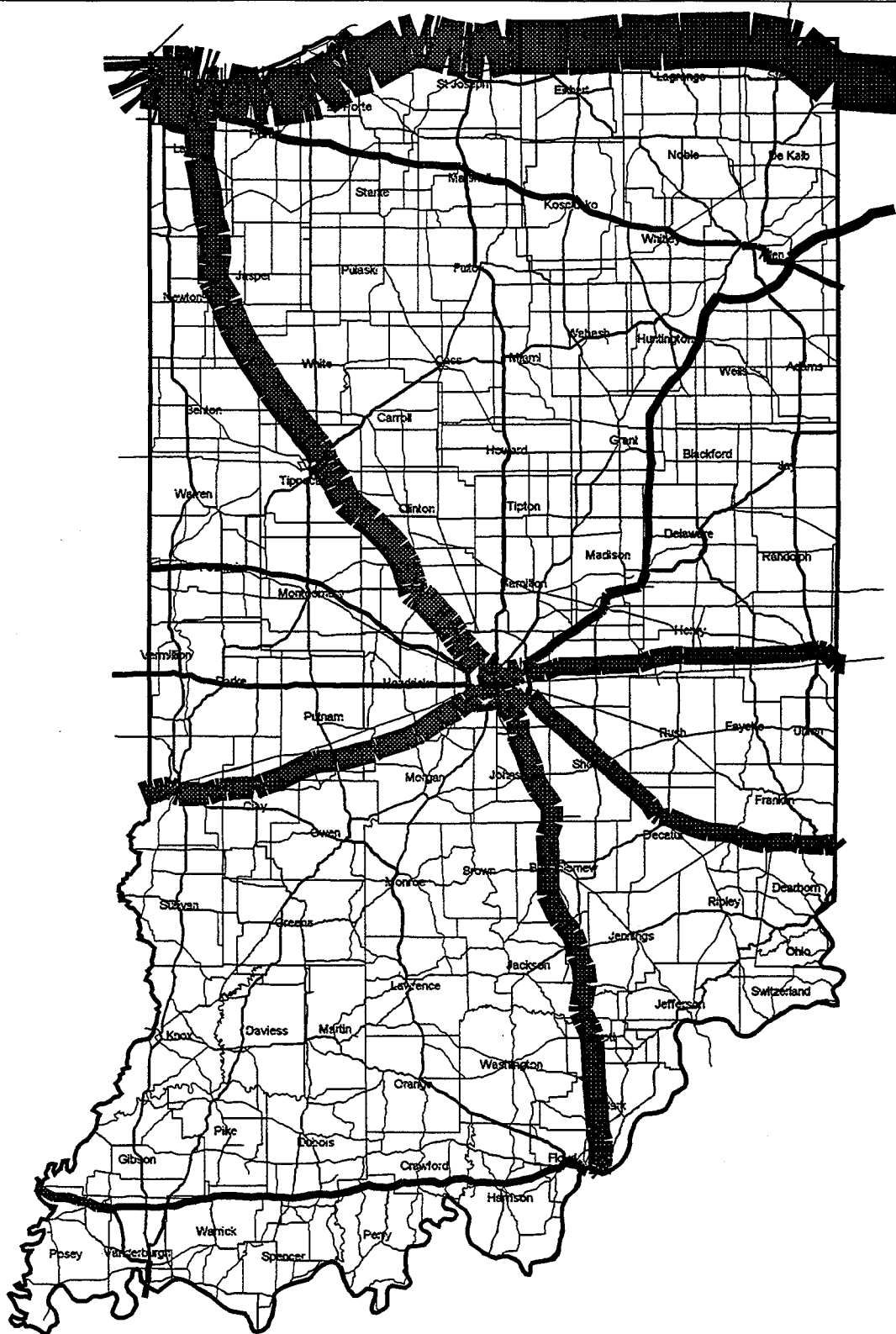
If one were to superimpose the Intermodal Freight Facilities map with those depicting the modal assignments, one would see that the rail/truck intermodal facilities identified in the second chapter are, for the most part, extremely well suited to take advantage of the existing highway and rail flows. The following "Harvey Ball" exhibit illustrates the point in a qualitative way.

Rail/Truck Intermodal Facility	Highway Market Access	Railroad Market Access
Indianapolis Avon Yard	●	●
Roanoke	◐	◐
Fort Wayne Triple Crown	◐	◐
Evansville CSX	○	●
Remington Hoosier Lift	●	○

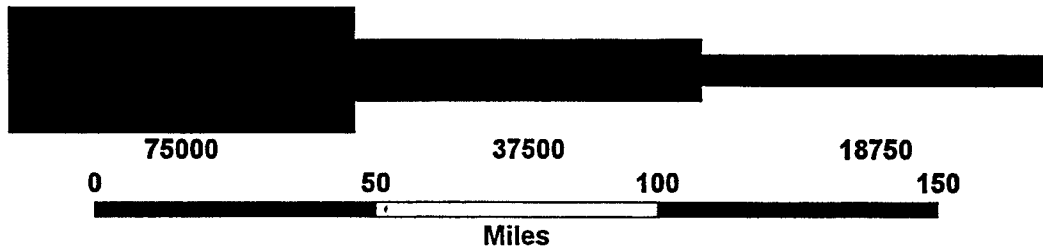


In the case of Evansville, the small quantity of truck flows seems to indicate a predominance of rail to barge moves (reinforced by what is now known about the coal rail flows). In the case of the Hoosier Lift, there is simply not much of an access to the main Indiana rail flows which tend to be eastward.

The lack of any rail/truck intermodal facilities on the dominant I-80/90 and CSX route corridor hints that many of the rail movements are made up of through movements that probably do not stop in Indiana.

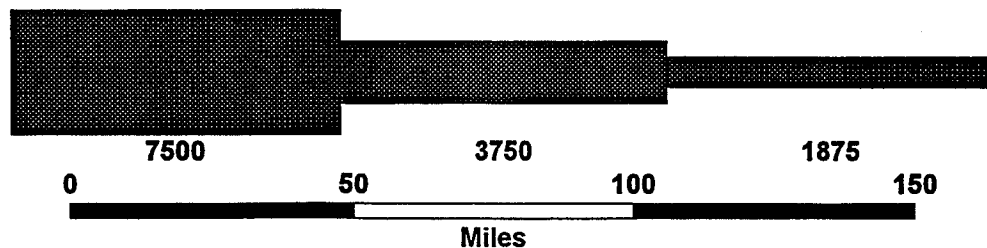


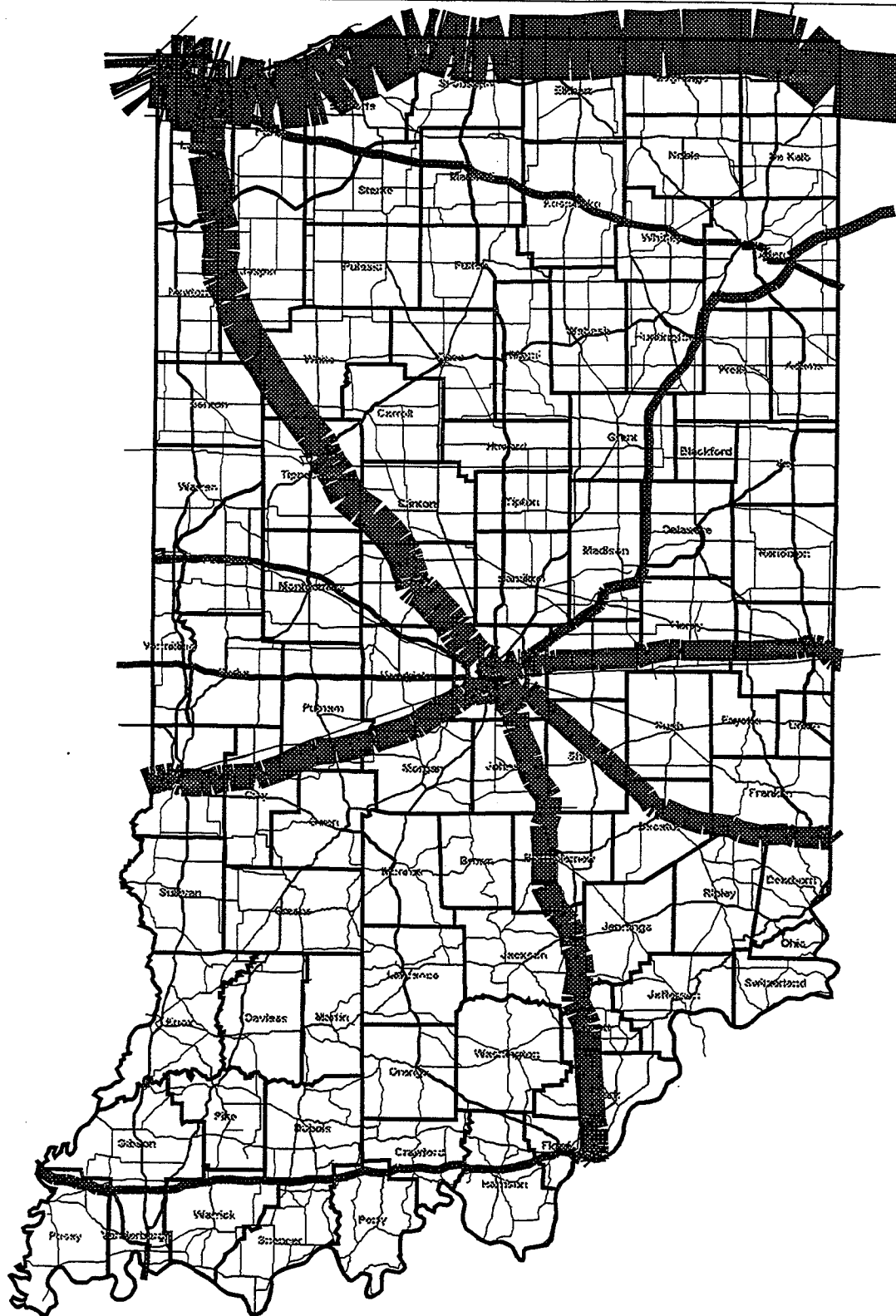
TOTAL COMMODITY FLOW - TRUCKLOADS 2005



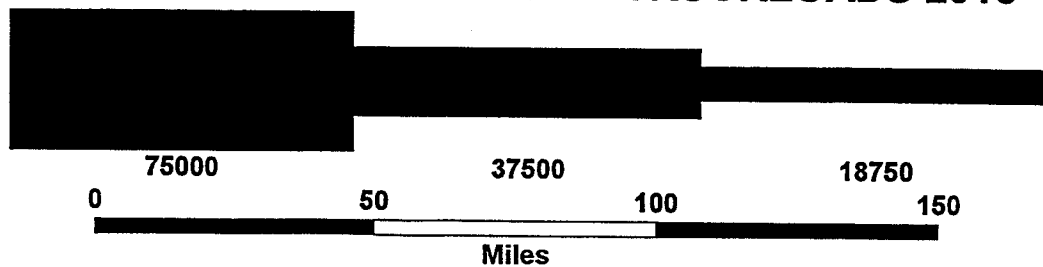


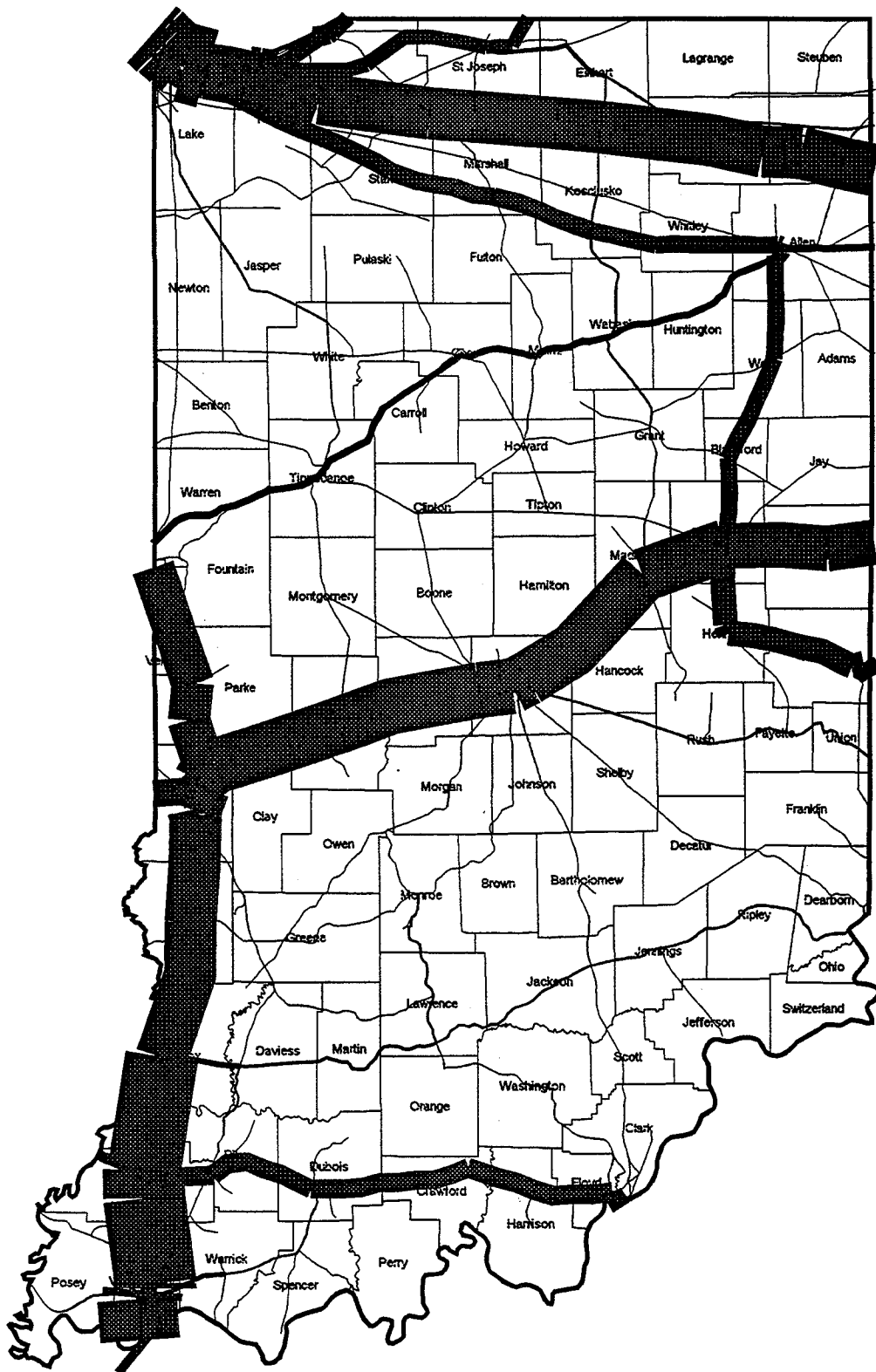
TOTAL COMMODITY FLOW - CARLOADS 2005



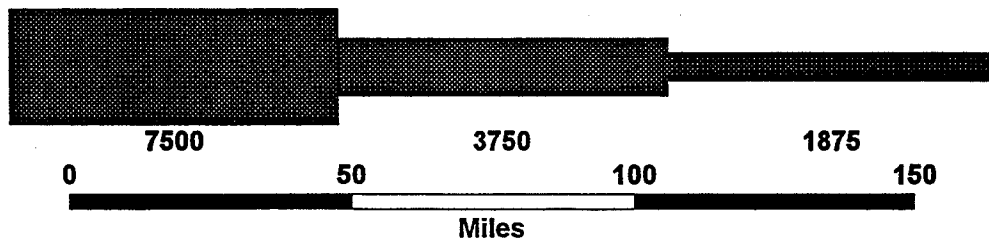


TOTAL COMMODITY FLOW - TRUCKLOADS 2015





TOTAL COMMODITY FLOW - CARLOADS 2015



Container Traffic

Some data are available on the movement of goods by container between Indiana and East Coast ports. Indiana also receives and ships containerized traffic through West Coast ports, but data are not available on these flows. The Transport Flows Study did not examine container flows as such. It simply regards these as rail or truck flows from Indiana to the various export states and whether the good is enclosed in a trailer or container is not explicitly of interest to the highway traffic situation, which was the focus of that study.

Nevertheless, the container flows available for East Coast ports indicate an overwhelming export dominance for Indiana's industries. Containerized exports weighed 104 thousand tons in comparison to imports of 53 thousand tons. Actual containers in this situation were 14.5 thousand for export and 6.3 thousand for import. The map on the following page illustrates containerized exports and imports by county for Indiana.

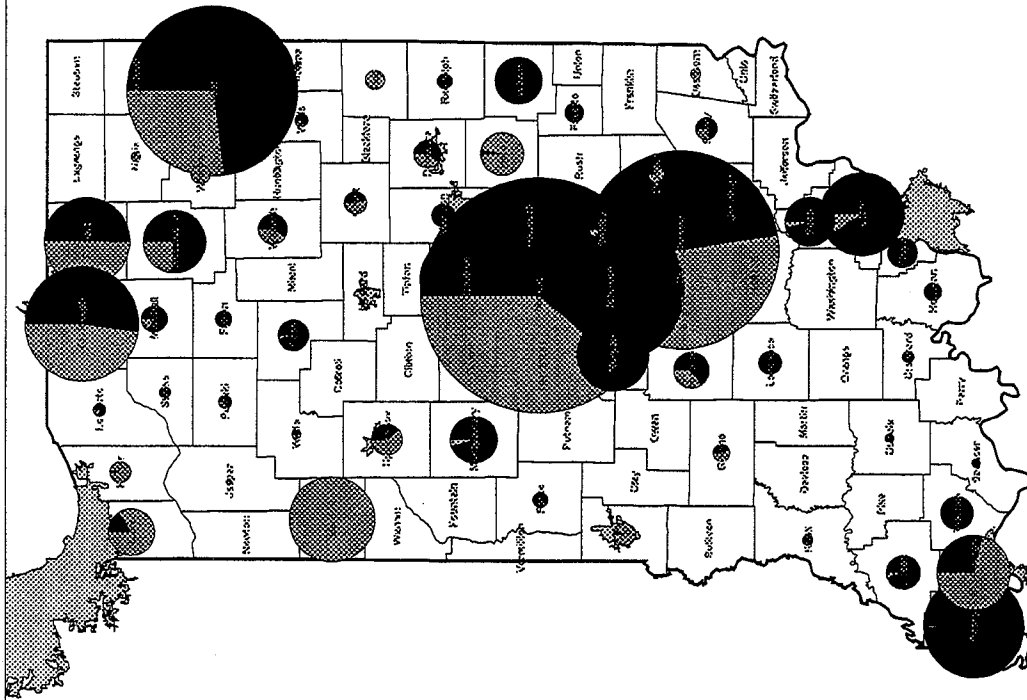
The contents of the various containers is proprietary. The density of goods may be of interest to researchers. This density factor is 8.48 tons per container for imports and 7.15 tons per container for exports.

Truck-Air Traffic

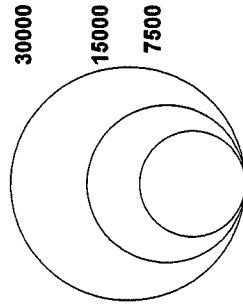
All air freight traffic would appear to be intermodal since it usually arrives or departs from the airport via motor carrier. Air freight was not examined as a single mode in the Transport Flow Study, instead it was considered as a mode that also uses highway transport as part of its moves. As a result, no assignments were developed for air movements, nor was data explicitly examined for Indiana's airport facilities.

Research undertaken during the IMS Study, however, indicates that air freight demand is highly concentrated around Indianapolis. Both Indianapolis International (1,386,000 short tons in 1994) and Terre Haute Hulman Regional (127,000 short tons) met the criteria for statewide significance for airports (defined in Chapter 2). Clearly the FedEx center in Indianapolis, the second largest such facility owned by the company, after Memphis, is the largest contributor to the Indianapolis air freight traffic. Fort Wayne International also carries considerable air freight and may now have reached the 100,000 short tons per year mark. The facility handled close to 72,000 short tons in 1994.

Overall in the State the percentage of truck-air freight traffic is lower than the national average for the value, but it is higher for the tonnage transported. Based on value, Indiana truck-air freight share was 1.9 percent (U.S. average: 2.3 percent). Based on tonnage, Indiana truck-air freight share was 0.06 percent (U.S. average: 0.03 percent).



Containerized Manufactured Goods (tons)



▲ Exports
▲ Imports



Imports and Exports via New York, 1992

Data disclosure problems prevent complete discussion of intermodal traffic by commodity for Indiana. Published data on the value of shipments originating in the state suggest that truck-air moves are the most important for shippers of machinery of all types (STCC 35 and STCC 36) and transportation equipment (STCC 37). In both cases it is quite likely that the item being transported would be parts, rather than machinery or vehicles. Still, the commodity codes listed explain the heavier than average Indiana truck-air movements.

Intermodal Traffic

It is probable that the major intermodal traffic of Indiana passes through the state as part of the "land bridge" between Asia and Europe. Shippers on these latter continents have found it efficient to move manufactured goods in containers by ocean transport to the East and West Coasts of the U.S. and then cross the North American continent by rail. Railroads have entered into agreements that allow the blocking of entire trains of containers, thus eliminating the need to move this traffic through congested railroad classification yards. Competitive alternatives to this routing would take smaller container ships through the Panama Canal or larger container ships around the southern edge of South America. This traffic has little economic significance for the state since it is overhead rail traffic. It does explain the heavy volume of traffic on the northern Indiana east-west rail lines.

These high volumes of the "land-bridge" are not apparent in the data presented in this report. Recall that the 1993 Commodity Flow Survey is shipper-based and since the shippers in each case are located outside the U.S., the flows are not included in the survey.

For Indiana as a whole intermodal transport is practically insignificant according to the 1993 flow survey. In terms of tonnage, intermodal traffic represented less than a quarter of one percent of the total. This is looking at truck-rail, truck-air, and truck-water moves. If we throw in private truck-for hire trucks as intermodal, the percentage climbs to just under 1.25. Intermodal traffic volume represents about 3.6% of the total traffic originated in the U.S.

If we look at the value of goods the numbers increase as one would expect. In this case intermodal traffic has 3.2% of the total shipment value in Indiana. For the nation this statistic is 4.7% of the total shipment value. Nearly half of these values come from intermodal truck-air transport.

The national trends discussed at the beginning of this chapter suggest that in the four years since the 1993 CFS the intermodal share of traffic is higher than depicted above. Still, using ten percent as an annual growth factor would bring the intermodal share to just under two percent of the total traffic originated in

the U.S. This is less than the national average and is explained by the heavy through traffic taking place on the State's northern border.